



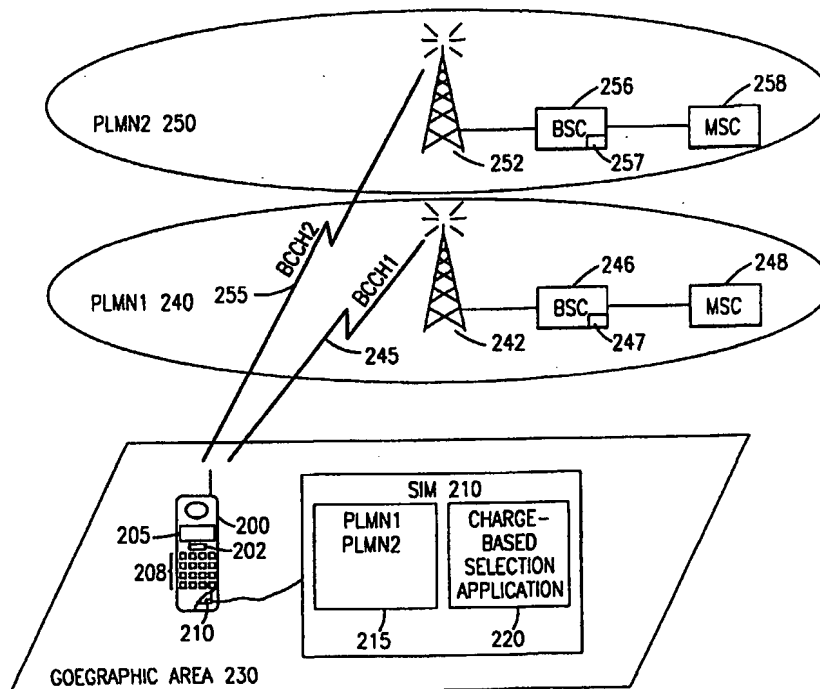
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : <b>H04M 15/28</b>	<b>A1</b>	(11) International Publication Number: <b>WO 99/30479</b> (43) International Publication Date: 17 June 1999 (17.06.99)
<p>(21) International Application Number: PCT/US98/26210</p> <p>(22) International Filing Date: 10 December 1998 (10.12.98)</p> <p>(30) Priority Data: 08/989,090 11 December 1997 (11.12.97) US</p> <p>(71) Applicant: ERICSSON INC. [US/US]; 7001 Development Drive, P.O. Box 13969, Research Triangle Park, NC 27709 (US).</p> <p>(72) Inventors: ALPEROVICH, Vladimir; 18419 Rain Dance Trail, Dallas, TX 75252 (US). BHATIA, Ranjit; 195 E. Round Grove Road #1527, Lewisville, TX 75067 (US).</p> <p>(74) Agents: MOORE, Stanley, R. et al.; Jenkins &amp; Gilchrist, P.C., Suite 3200, 1445 Ross Avenue, Dallas, TX 75202 (US).</p>	<p>(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</p> <p><b>Published</b> With international search report.</p>	

(54) Title: SYSTEM AND METHOD FOR CELLULAR NETWORK SELECTION BASED ON ROAMING CHARGES

## (57) Abstract

A telecommunications system and method is disclosed for selecting a cellular network by a mobile terminal, while roaming outside of the subscribers home cellular network, based on charging information associated with each cellular network available to the subscriber of the mobile terminal. The cellular networks within the geographical area of the mobile terminal can broadcast the charging information applicable to roaming subscribers from other networks. The identity of each cellular network within the geographical area of the mobile terminal and associated charging information is received by the mobile terminal, which can then select the least cost cellular network. For manual selection, the identity of each available cellular network and associated charging information received by the mobile terminal is displayed to the subscriber, to allow the subscriber to select the desired cellular network.



**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
DJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

## SYSTEM AND METHOD FOR CELLULAR NETWORK SELECTION BASED ON ROAMING CHARGES

### BACKGROUND OF THE PRESENT INVENTION

#### 5        Field of the Invention

The present invention relates generally to telecommunications systems and methods for selecting a cellular network for use by a mobile terminal, and specifically to allowing a subscriber to select a cellular network, while roaming outside of the subscriber's home cellular network, based on charging information associated with each cellular network available to the subscriber.

#### 10        Background and Objects of the Present Invention

Cellular telecommunications is one of the fastest growing and most demanding telecommunications applications ever. Today it represents a large and continuously increasing percentage of all new telephone subscriptions around the world. A standardization group, European Telecommunications Standards Institute (ETSI), was established in 1982 to formulate the specifications for the Global System for Mobile Communication (GSM) digital mobile cellular radio system.

With reference now to FIGURE 1 of the drawings, there is illustrated a GSM Public Land Mobile Network (PLMN), such as cellular network 10, which in turn is composed of a plurality of areas 12, each with a Mobile Switching Center (MSC) 14 and an integrated Visitor Location Register (VLR) 16 therein. The MSC/VLR areas 12, in turn, include a plurality of Location Areas (LA) 18, which are defined as that part of a given MSC/VLR area 12 in which a mobile station (MS) (terminal) 20 may move freely without having to send update location information to the MSC/VLR area 12 that controls the LA 18. Each Location Area 12 is divided into a number of cells 22.

Mobile Station (MS) 20 is the physical equipment, e.g., a car phone or other portable phone, used by mobile subscribers to communicate with the cellular network 10, each other, and users outside the subscribed network, both wireline and wireless. The MS 20 may also include a Subscriber Identity Module (SIM) card 13, or other

-2-

memory, which provides storage of subscriber related information, such as a subscriber authentication key, temporary network data, and service related data (e.g. language preference).

5 The MSC 14 is in communication with at least one Base Station Controller (BSC) 23, which, in turn, is in contact with at least one Base Transceiver Station (BTS) 24. The BTS is the physical equipment, illustrated for simplicity as a radio tower, that provides radio coverage to the geographical part of the cell 22 for which it is responsible. It should be understood that the BSC 23 may be connected to several base transceiver stations 24, and may be implemented as a stand-alone node or  
10 integrated with the MSC 14. In either event, the BSC 23 and BTS 24 components, as a whole, are generally referred to as a Base Station System (BSS) 25.

With further reference to FIGURE 1, the PLMN Service Area or cellular network 10 includes a Home Location Register (HLR) 26, which is a database maintaining all subscriber information, e.g., user profiles, current location information,  
15 International Mobile Subscriber Identity (IMSI) numbers, and other administrative information. The HLR 26 may be co-located with a given MSC 14, or alternatively can service multiple MSCs 14, the latter of which is illustrated in FIGURE 1.

The VLR 16 is a database containing information about all of the Mobile Stations 20 currently located within the MSC/VLR area 12. If a MS 20 roams into a  
20 new MSC/VLR area 12, the VLR 16 connected to that MSC 14 will request data about that Mobile Station 20 from the HLR database 26 (simultaneously informing the HLR 26 about the current location of the MS 20). Accordingly, if the user of the MS 20 then wants to make a call, the local VLR 16 will have the requisite identification information without having to reinterrogate the HLR 26. In the aforescribed  
25 manner, the VLR and HLR databases 16 and 26, respectively, contain various subscriber information associated with a given MS 20.

When a subscriber is roaming outside of the subscribers home PLMN, the subscriber often has a choice of several other cellular networks. Currently, the selection of the network for use by the MS 20 is based on a list of PLMNs available  
30 to the subscriber, stored, for example, within the SIM card 13, or other programmable memory, within the MS 20. Once this list is created, the first PLMN on the list is

-3-

selected whenever possible. In many situations, the subscriber may also select the PLMN manually.

However, at present, only the network name (identity) is displayed to the subscriber prior to the subscriber making a manual selection of the desired cellular network. Therefore, in either of the above situations, the chosen cellular network may not provide the lowest rates to the roaming subscriber.

It is therefore an object of the invention to allow a subscriber to select a cellular network, while roaming, based on both the identity of the cellular network and the charging information associated therewith.

#### SUMMARY OF THE INVENTION

The present invention is directed to telecommunications systems and methods for allowing a subscriber to select a cellular network (PLMN), while roaming outside of the subscribers home cellular network, based on charging information received by the subscribers mobile terminal for each cellular network available to the subscriber. This can be accomplished by allowing PLMNs within the geographical area of the mobile terminal to broadcast the charging information applicable to roaming subscribers from other networks. This information can be broadcast, for example, on a Broadcast Control Channel (BCCH), for GSM-based systems. The identity of each PLMN within the geographical area of the MS is received by the MS and compared with a list of allowable PLMNs stored in the SIM card to determine which PLMNs are available to the subscriber. Thereafter, if more than one PLMN is available to the subscriber, charging information associated with each available PLMN is received by the MS/SIM, which can then select the least cost PLMN. For manual PLMN selection, the identity of each available PLMN and associated charging information is received by the MS/SIM and displayed to the subscriber, to allow the subscriber to select the desired (least cost) PLMN.

## BRIEF DESCRIPTION OF THE DRAWINGS

The disclosed inventions will be described with reference to the accompanying drawings, which show important sample embodiments of the invention and which are incorporated in the specification hereof by reference, wherein:

FIGURE 1 is a block diagram of a conventional terrestrially-based wireless telecommunications system;

FIGURE 2 illustrates a choice of cellular networks available to a mobile terminal while roaming; and

FIGURE 3 describes steps in a sample cellular network selection process based on charging information, in accordance with preferred embodiments of the present invention.

## DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EXEMPLARY EMBODIMENTS

The numerous innovative teachings of the present application will be described with particular reference to the presently preferred exemplary embodiments. However, it should be understood that this class of embodiments provides only a few examples of the many advantageous uses of the innovative teachings herein. In general, statements made in the specification of the present application do not necessarily delimit any of the various claimed inventions. Moreover, some statements may apply to some inventive features but not to others.

With reference now to FIGURE 2 of the drawings, a Mobile Station (MS) 200, which has roamed outside of its home Public Land Mobile Network (PLMN), often has a choice of PLMN's (PLMN1 240 and PLMN2 250) within a geographic area 230. Each PLMN (240 and 250) within that geographic area 230 broadcasts information related to that PLMN (240 and 250, respectively). For example, each PLMN (240 and 250) can broadcast the respective network code (PLMN identity information) and synchronization information. The MS 200 has the capability to receive messages from each PLMN (240 and 250) at the same time, while roaming in the geographic area 230 designated to these PLMNs (240 and 250). In order for the MS 200 to determine which PLMN (240 or 250) to use, each PLMN (240 and 250) can also broadcast the

-5-

charging information associated therewith, which is applicable to all roaming MSs 200 within that geographical area 230. This information can be broadcast, for example, on separate Broadcast Control Channels (BCCH) (245 and 255) for each PLMN (240 and 250, respectively), for GSM-based systems.

5           As described in FIGURE 3 of the drawings, for the purpose of PLMN selection based on roaming charges, the charging information for each PLMN (240 and 250) is entered into a charging application (247 and 257, respectively) within a Base Station Controller (BSC) (246 and 256, respectively) associated with each PLMN (240 and 250) (step 300). Alternatively, the charging application (247 and 257) can be located  
10           within a Mobile Switching Center (248 and 258, respectively) connected to the BSC (246 and 256, respectively). The charging information can be updated in the BSC (246 and 256) or MSC (248 and 258) by various methods, such as by manual commands. This charging information and the PLMN identity information is then sent to the Base Transceiver Station (242 and 252) to be broadcast on the BCCH (245 and 255,  
15           respectively) (step 310).

          Thereafter, the charging information and PLMN identity information can be received by a Subscriber Identity Module 210, or other programmable memory, within the MS 200 (step 320). A list 215 containing the PLMNs allowed to the subscriber is stored in the SIM card 210. Not all PLMNs (240 and 250) within a geographical area  
20           230 are allowed to a roaming subscriber. The allowability of a PLMN (240 or 250) depends upon the agreement between the subscribers home PLMN (not shown) and the PLMNs (240 and 250) within the geographical area 230 the MS 200 is in. This list of allowable PLMNs 215 within the SIM card 210 can then be compared with the received PLMN identity information (step 330) to determine which PLMNs within the  
25           geographical area 230 are available to the subscriber. If there is only one received PLMN identity on the list 215, for example, PLMN1 240, the MS 200 registers with that PLMN 240 (step 340).

          However, if the mobile subscriber has several available PLMNs (240 and 250), the MS 200 then collects the roaming charge information received on the BCCH  
30           channels (245 and 255, respectively) by the MS 200 for all of the available PLMNs (240 and 250) (step 350). After collecting the charging information (step 350), a

-6-

PLMN charge-based selection application 220 within the SIM card 210 compares the received charging information for each available PLMN (240 and 250) (step 360) and registers, e.g., by performing a location update, as is well known in the art, with the PLMN (240 or 250) having the lowest charging rate (step 370).

5           For manual PLMN selection, the roaming charges can be displayed to the subscriber on a display 205, along with the received PLMN identities that are on the list 215 (available PLMNs 240 and 250). The subscriber can then have the option of selecting the least cost PLMN, or another PLMN, using, for example, existing function keys 202 on the keypad 208 of the MS 200.

10           As will be recognized by those skilled in the art, the innovative concepts described in the present application can be modified and varied over a wide range of applications. Accordingly, the scope of patented subject matter should not be limited to any of the specific exemplary teachings discussed.



-7-

**WHAT IS CLAIMED IS:**

1. A telecommunications system for selecting a given one of a plurality of cellular networks based on charging information associated with said given cellular network, said telecommunications system comprising:

5 a mobile terminal in wireless communication with each of said cellular networks;

transmission means for transmitting, by each of said cellular networks, charging information associated with each of said cellular networks to said mobile terminal; and

10 selection means within said mobile terminal for selecting said given cellular network, using said charging information associated with said given cellular network, said charging information associated with said given cellular network having a rate lower than said charging information associated with nonselected ones of said cellular networks.

15

2. The telecommunications system of Claim 1, wherein each of said cellular networks has a base station system.

3. The telecommunications system of Claim 2, wherein said base station  
20 system includes a base station controller and a base transceiver station, said transmission means including said base transceiver station.

4. The telecommunications system of Claim 1, wherein said mobile  
terminal has a memory located therein for storing a list of allowable ones of said  
25 cellular networks.

-8-

5. The telecommunications system of Claim 4, wherein each of said cellular networks has an identity associated therewith, said transmission means for each of said cellular networks transmitting said identity of each of said cellular networks to said mobile terminal, said mobile terminal comparing each said identity with said list of allowable cellular networks to determine available ones of said cellular networks.

6. The telecommunications system of Claim 5, wherein said given cellular network is selected from said available cellular networks.

7. The telecommunications system of Claim 4, wherein said memory is a Subscriber Identity Module.

8. The telecommunications system of Claim 1, wherein said mobile terminal has reception means therein for receiving said charging information associated with each of said cellular networks.

9. The telecommunications system of Claim 8, wherein said reception means includes a Subscriber Identity Module, said Subscriber Identity Module comparing said charging information associated with each of said cellular networks, said selection means being included within said Subscriber Identity Module.

10. The telecommunications system of Claim 1, wherein said selection means consists of displaying said charging information associated with each of said cellular networks on a display on said mobile terminal and depressing at least one key on said mobile terminal.

11. The telecommunications system of Claim 1, wherein each of said cellular networks has a base station controller in wireless communication with said mobile terminal, said charging information associated with each of said cellular networks being stored in a respective one of said base station controllers.

-9-

12. The telecommunications system of Claim 1, wherein each of said cellular networks has a mobile switching center in wireless communication with said mobile terminal, said charging information associated with each of said cellular networks being stored in a respective one of said mobile switching centers.

5

13. The telecommunications system of Claim 1, wherein said transmission means consists of broadcasting said charging information associated with each of said cellular networks on a respective broadcast control channel.

10

14. A method for selecting a given one of a plurality of cellular networks based on charging information associated with said given cellular network, by a mobile terminal in wireless communication with each of said cellular networks, said method comprising the steps of:

transmitting, by each of said cellular networks, charging information associated with each of said cellular networks;

receiving, by said mobile terminal, said charging information associated with each of said cellular networks; and

selecting, by said mobile terminal, said given cellular network, using said charging information associated with said given cellular network, said charging information associated with said given cellular network having a rate lower than said charging information associated with nonselected ones of said cellular networks.

20

15. The method of Claim 14, wherein each of said cellular networks has a base station system.

25

16. The method of Claim 15, wherein said base station system includes a base station controller and a base transceiver station, said step of transmitting being performed by said base transceiver station.

30

17. The method of Claim 14, wherein said mobile terminal has a memory located therein for storing a list of allowable ones of said cellular networks.

-10-

18. The method of Claim 17, wherein each of said cellular networks has an identity associated therewith, and further comprising, before said step of transmitting said charging information, the steps of:

transmitting, by each of said cellular networks, said identity of each of said  
5 cellular networks to said mobile terminal;

comparing, by said mobile terminal, each said identity with said list of allowable cellular networks; and

determining, by said mobile terminal, available ones of said cellular networks.

10 19. The method of Claim 18, wherein said given cellular network is selected from said available cellular networks.

20. The method of Claim 17, wherein said memory is a Subscriber Identity  
Module.

15 21. The method of Claim 14, wherein said step of receiving is performed by a Subscriber Identity Module located within said mobile terminal, said Subscriber Identity Module comparing said charging information associated with each of said cellular networks, said step of selecting being performed by said Subscriber Identity  
20 Module.

22. The method of Claim 14, wherein said step of selecting is performed by displaying said charging information associated with each of said cellular networks on a display on said mobile terminal and depressing at least one key on said mobile  
25 terminal.

23. The method of Claim 14, wherein each of said cellular networks has a base station controller in wireless communication with said mobile terminal, said charging information associated with each of said cellular networks being stored in a  
30 respective one of said base station controllers.

-11-

24. The method of Claim 14, wherein each of said cellular networks has a mobile switching center in wireless communication with said mobile terminal, said charging information associated with each of said cellular networks being stored in a respective one of said mobile switching centers.

5

25. The method of Claim 14, wherein said step of transmitting is performed by each of said cellular networks broadcasting said charging information associated with each of said cellular networks on a respective broadcast control channel.

10

26. A mobile terminal for selecting a given one of a plurality of cellular networks based on charging information associated with said given cellular network, said mobile terminal comprising:

reception means for receiving charging information associated with each of said cellular networks;

15

a memory unit for storing said received charging information; and

selection means for selecting said given cellular network, said charging information associated with said given cellular network having a rate lower than said charging information associated with nonselected ones of said cellular networks.

20

27. The mobile terminal of Claim 26, wherein said receiving means further receives identity information associated with each of said cellular networks, and further comprising comparison means for comparing said identity information associated with each of said cellular networks with a list of allowable cellular networks, stored within said memory unit, to determine available ones of said cellular network, said given cellular network being selected from said available cellular networks.

25

28. The mobile terminal of Claim 26, wherein said memory unit is a Subscriber Identity Module.

30

-12-

29. The mobile terminal of Claim 26, wherein said selection means comprises displaying said charging information associated with each of said cellular networks on a display to a subscriber, said subscriber pressing at least one key to select said given cellular network.

5

30. The mobile terminal of Claim 26, wherein said receiving means and said selection means comprises said memory unit.

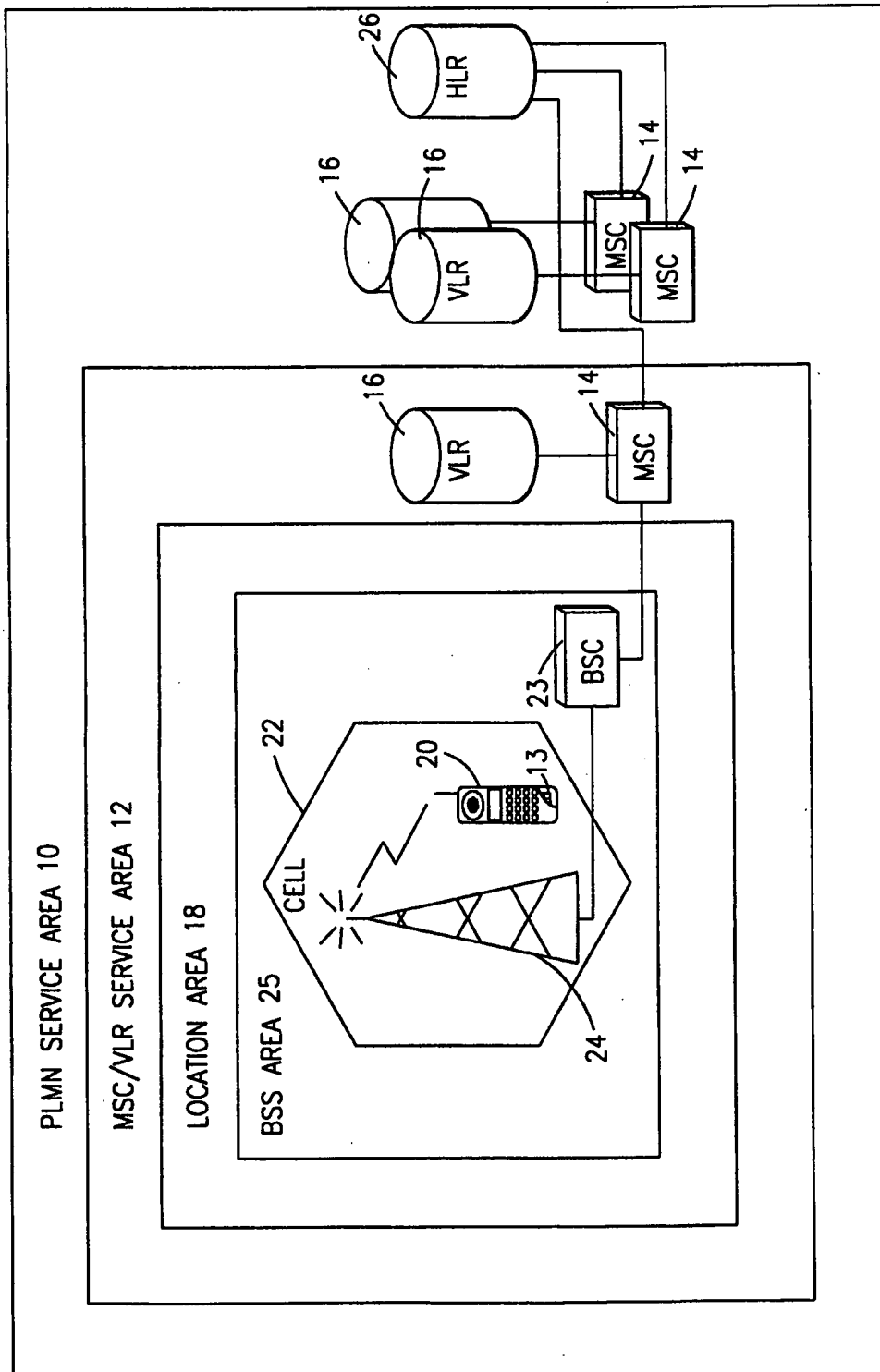


FIG. 1

2/3

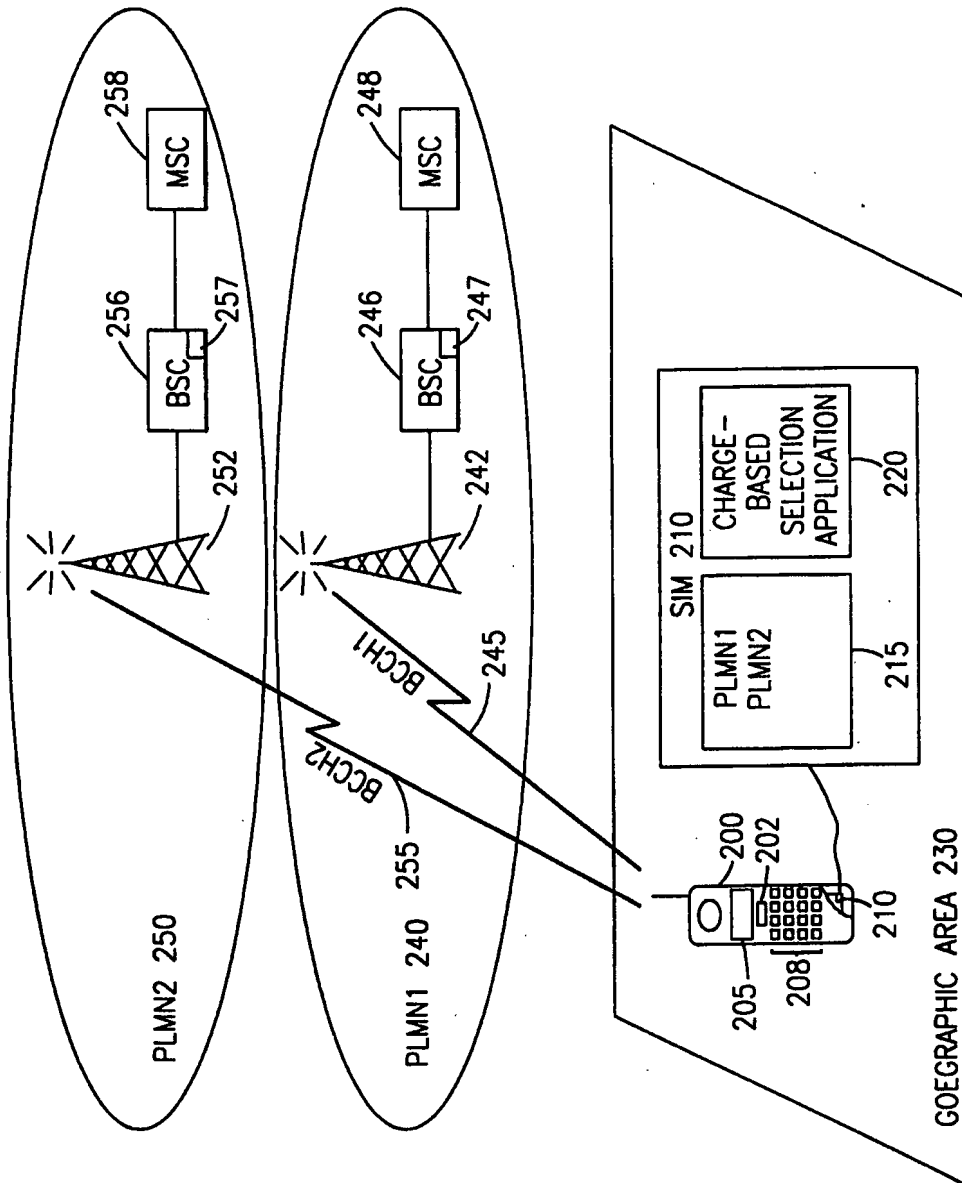
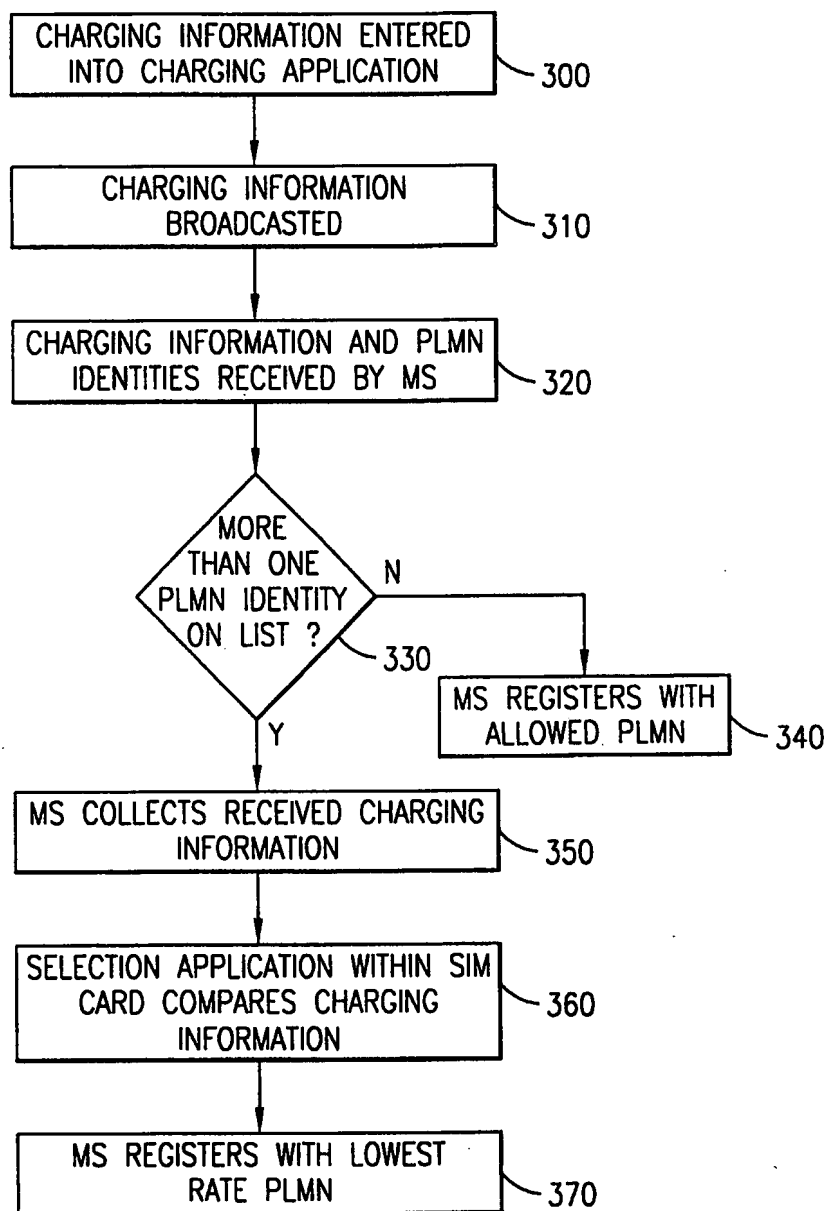


FIG. 2



3/3

**FIG. 3**

# INTERNATIONAL SEARCH REPORT

Application No

PCT/US 98/26210

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 H04M15/28

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H04M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 724 371 A (CABLE & WIRELESS PLC) 31 July 1996 see page 1, line 3 - line 29 see page 3, line 50 - page 4, line 38 ---	1-30
X	EP 0 808 073 A (MOTOROLA LTD) 19 November 1997 see column 3, line 31 - column 4, line 20 see claims 1-7, 16, 17 see figure 2 ---	1-30
X	WO 94 28683 A (BRITISH TELECOMM) 8 December 1994 see page 11, line 28 - page 14, line 17 ---	1-30
A	US 5 675 636 A (GRAY THOMAS A) 7 October 1997 see column 2, line 1 - line 62 -----	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

### \* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

18 March 1999

Date of mailing of the international search report

26/03/1999

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Neves Appelt, D

# INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/US 98/26210

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0724371 A	31-07-1996	NONE	
EP 0808073 A	19-11-1997	GB 2313256 A	19-11-1997
WO 9428683 A	08-12-1994	AU 700554 B	07-01-1999
		AU 6729994 A	20-12-1994
		AU 9415198 A	04-02-1999
		AU 9415398 A	04-02-1999
		CA 2159829 A	08-12-1994
		CN 1124558 A	12-06-1996
		EP 0700625 A	13-03-1996
		SG 43106 A	17-10-1997
		US 5802502 A	01-09-1998
		JP 9504912 T	13-05-1997
US 5675636 A	07-10-1997	CA 2123068 A	07-11-1995
		DE 19516364 A	09-11-1995
		GB 2289599 A, B	22-11-1995